4.0 WATER SUPPLY PLANNING

4.1 PURPOSE

The purpose of this chapter is to ensure that recycled water planning is consistent with the City's overall water supply planning goals. This chapter provides a description of the various planning documents related to water supply planning and management within the City of Lincoln.

This chapter is divided into the following sections:

- Water Master Plan
- Urban Water Management Plan
- American River Basin Integrated Regional Water Management Plan
- Water Supply Planning Goals Summary

4.2 WATER MASTER PLAN

A Water Master Plan is a comprehensive document that provides an overview and analysis of water supply infrastructure, future supply and demand projections, and strategies for maintaining and expanding the purveyor's existing supplies and facilities. The City of Lincoln's Water Master Plan was prepared by Tully and Young and finalized in September of 2017.

The City's potable retail water system is supplied by two water sources, wholesale water delivered through Placer County Water Agency (PCWA)'s water system and groundwater derived from the City's wells.

Between 2010 and 2015, the City's highest annual potable water demand reached 10,858 acre-feet per year (AF/yr) in 2013, prior to water use reduction orders issued by the State Water Resources Control Board. Water reduction mandates and conservation strategies were implemented in response to severe drought conditions.

The Water Master Plan approximates the future annual potable water demand as 36,000 acre-feet (AF) at buildout, this equates to an Average Day Demand (ADD) of approximately 32 million gallons per day (MGD). Maximum Day Demand (MDD) under buildout conditions is used for purposes of infrastructure planning. The City has established a MDD of 67 MGD. Approximately 57 MGD of capacity will be needed to meet potable domestic water demands while the remaining 10 MGD of capacity will be needed to meet non-potable water demands. These non-potable demands will be derived from separate non-potable distribution systems supplied by raw or recycled water.

The Water Master Plan recommends that the City expand support for PCWA and Nevada Irrigation District (NID) raw water supplies and to further expand use of recycled water, offsetting potable demands.

4.3 URBAN WATER MANAGEMENT PLAN

The City of Lincoln's Urban Water Management Plan (UWMP) was prepared by Tully and Young in 2016, to satisfy the requirements of the Urban Water Management Planning Act (UWMPA), as required by the State of California. The UWMP requires consideration of recycled water opportunities, including capacity of the wastewater collection systems, quality of the wastewater. The suitability of various uses and applications, and the potential demand within the urban water purveyor's jurisdiction for recycled water. The following issues were considered within the Urban Water Master Plan:

1. The manner in which recycled water is classified in the supply and demand analysis
2. The costs and benefits of developing recycled water infrastructure
3. The ability to ensure that the recycled water meets water quality discharge standards promulgated by the Regional Water Quality Control Board for various applications

The UWMP concludes that the City's water supply portfolio is robust enough to provide security for the City's long-term water planning. Future recycled water supplies estimated in the UWMP are presented in **Table 4-1**.

Table 4-1 UWMP Recycled Water Supply Projections

Water Source	2020	2025	2030	2035	2040
Recycled Water (AF/year)	3,300	3,748	4,381	5,015	6,063

4.4 AMERICAN RIVER BASIN INTEGRATED REGIONAL WATER MANAGEMENT PLAN

The American River Basin (ARB) regional planning objectives include increasing the use of recycled water in the future. Project 14 - Lincoln Recycled Water Distribution System Expansion - Southwest Placer County (City of Lincoln), was included as part of the American River Basin (ARB)'s Integrated Regional Water Management Plan (IRWMP). This project was one of fourteen initial projects included in the ARB IRWMP that were developed to assist the ARB region in achieving the following objectives: water supply reliability, stormwater and flood plain management, groundwater management, ecosystem restoration, and recycled water and water quality. The project is supported by the Proposition 50, Chapter 8 Integrated Regional Water Management Grant Program and local matching funds.

The participants of the IRWMP recognize that implementation of multiple water management strategies necessary to achieve regional objectives. Consequently, the following regional priorities are identified in the IRWMP as measures intended to help achieve regional objectives.

Bolded items identify priorities that are satisfied by expansion of the City's reclamation system and use of recycled water.

1. **Water Supply Reliability**
2. **Groundwater Management**
3. **Water Quality Protection and Improvement**
4. Ecosystem Restoration
5. Conjunctive Use
6. **Environmental and Habitat Protection and Improvement**
7. Storm Water Management
8. Flood Management
9. **Water Recycling**
10. **Water Conservation**
11. **Water and Wastewater Treatment**
12. Wetlands Enhancement and Creation
13. Recreation and Public Access
14. NPS Pollution Control
15. **Watershed Planning**
16. Land Use Planning
17. Creating Linkages to Regional Infrastructure
18. Includes Regional Partners

The intended goals of Project 14 were to:

1. Maximize use of recycled water by local industries, public facilities, and other end users to help increase water supply reliability.
2. Provide high quality reclaimed water to ensure protection of human health and public acceptance of reclaimed wastewater.
3. Reduce diversions from raw water sources.
4. Reduce groundwater pumping during peak demand of non-potable uses.

The desired outcomes of Project 14 are to:

1. Meet non-potable demand of urban end users by providing recycled water service.
2. Ensure compliance with Title 22 requirements.
3. Higher stream flow conditions in raw water sources, along with possible cooler water temperatures.
4. Reduce the amount of groundwater pumped to meet non-potable urban water needs.

Water recycling is an important strategy for improving dry-year water supply needs, which is one of the seven major elements of the Water Forum Agreement (WFA) and one of the most important regional objectives of the IRWMP.

4.5 WATER SUPPLY PLANNING GOALS SUMMARY

The City's Water Master Plan (WMP) and Urban Water Master Plan (UWMP) describe all the City's existing and future water supply sources. The City's water supply portfolio consists of the following sources:

- PCWA Treated Water, under a water supply contract;

- NID Treated Water, under a temporary water service contract;
- Groundwater, through overlying and appropriative water rights;
- PCWA Raw Water, through a raw water service contract;
- NID Raw Water, through a water services contract; and
- Recycled Water, WWTRF

The City of Lincoln holds treated water supply contracts with Placer County Water Authority (PCWA) and Nevada Irrigation District (NID), who have planned to serve their respective service areas within the City's existing and future boundaries. The City also receives PCWA raw water for irrigation purposes via the Caperton Canal. This delivery is made through a raw water contract paid for by the City of Lincoln. Areas within the City and its SOI receive NID raw water service for irrigation purposes, including Turkey Creek Golf Course and Lincoln Crossing. These water deliveries are not supplied by the City. In addition to raw water, the City has seven groundwater wells that are currently used to augment potable water supplies to under peak demand conditions, provide emergency backup, and address drought conditions. The wells are interspersed throughout the City's potable water infrastructure system. Five of the seven wells are currently active within the domestic water system.

In summary, the City's goal to increase use of recycled water conforms with the local, state, and regional water supply planning goals. Based on review of applicable planning documents, the use of recycled water is viewed as a "potable water demand offset", as opposed to a new source of water supply. Recycled water presents unique water supply demand reduction opportunities which can be realized through application of such water for approved uses. To take full advantage of these opportunities, the City will have to construct recycled water infrastructure for its distribution and use. It is understood that the City has already started making these infrastructure investments and will continue down this path to reach its ultimate water supply planning goals.

5.0 EXISTING RECLAMATION SYSTEM

5.1 PURPOSE

The purpose of this chapter is to provide a description of the City of Lincoln's existing reclamation system and facilities including the existing recycled water distribution system, storage facilities, and recycled water use areas.

This chapter is divided into the following sections:

- Treatment – Lincoln WWTRF
- Storage – Tertiary Storage
- Distribution – Reclamation System
- Disposal – Use Areas and Discharges

5.2 TREATMENT – LINCOLN WWTRF

The City collects and treats wastewater from residents within city limits, serving a population of approximately 47,000 residents and a number of industrial and commercial users. The WWTRF also accepts and treats regional wastewater flow from Placer County's Sewer Maintenance District No. 1 (SMD1) subject to a Joint Exercise of Powers Agreement. The WWTRF Expansion Project (CIP 411) will expand the existing treatment capacity of the WWTRF. The details of this project are described in **Section 2.4**. **Table 5-1** presents the existing hydraulic capacities, as well as those associated with the phased expansion project.

Table 5-1 WWTRF Hydraulic and Treatment Capacities

Hydraulic Capacity					
Item	**Abbreviation**	**Units**	**Existing**	**Phase I Expansion**	**Phase II Expansion**
Average Dry Weather Flow	ADWF	MGD	5.9	7.1	8.0
Average Annual Flow	AAF	MGD	6.9	8.3	9.3
Peak Month Flow	PMF	MGD	10.6	12.4	13.7
Maximum Daily Flow	MDF	MGD	20.3	23.2	25.4
Peak Hour Flow	PHF	MGD	29.5	33.4	36.3

Final effluent from the WWTRF is used to supply the City's reclamation system. Water that isn't used as it is produced is sent to tertiary storage facilities. Before entering the distribution system, water can be re-treated using a dissolved air floatation tank (DAFT) system, which removes algae and other contaminants that may have been introduced during storage. The after start-up and operation of recycled water irrigation at city parks, it was determined that inline filtration and disinfection would further improve water quality at use locations within the City and reduce operation and maintenance activities. Therefore, inline filtration was included at park sites included as part of the Phase II Reclamation Project. The City also plans to include large scale inline filters and disinfection along the primary transmission main serving the City as part of the WWTRF Expansion Project. This additional treatment step helps to reduce growth and build up within the distribution system and reduces the operation and maintenance actives associated with recycled water use in irrigation systems.

5.3 STORAGE – TERTIARY STORAGE

The Tertiary Storage Basins (TSBs) at the WWTRF provide seasonal storage of tertiary treated and disinfected wastewater until disposal is feasible or reclaimed water demand exists. The existing TSBs have a combined capacity of 190 MG, and the on-going WWTRF Expansion Project will provide an additional 142 MG of on-site storage capacity to accommodate the WWTRF Expansion Project for a total storage volume of approximately 332 MG. Recycled water can be pulled from the TSBs during times of high irrigation demand and low effluent production flow.

The required amount of storage volume within the TSBs is determined by the extent that plant effluent flows exceed allowable creek discharges throughout the fall, winter, and spring. A water balance calculation is used to estimate all inflows and outflows within the system. In practice, the primary period of creek discharge occurs in winter months and main period of reclamation occurs in the summer months. To date, the TSB design volume has been minimized based on an effluent management strategy that maximizes discharge and disposal. This approach to design reduces costs associated with additional TSB volume. Historically, this design approach has not considered optimizing or maximizing reclamation potential.

Discharges to the creek are limited in accordance with the WWTRF wastewater discharge permit, Order No. R5-2018-0081 (NPDES No. CA0084476), and the Wastewater Change Petition WW0066 described in **Section 3.4**. The most recent update imposed more stringent receiving water temperature limitations, which may require that the WWTRF store more effluent as opposed to discharging it to Auburn Ravine. The revised receiving water limits were developed without conducting a site-specific study and are based on conservative assumptions. A time schedule order was issued by the RWQCB which provides regulatory coverage and an interim solution to wastewater storage and disposal issues while the City develops a long-term solution. The City intends to conduct a site-specific temperature study before moving forward with costly storage improvements. The RWQCB has approved the use of a nearby Regional Stormwater Basin (RSB) to provide additional storage to comply with the limitations during interim conditions. Further discussion of the time schedule order is provided in **Section 7.4**. A summary of the available tertiary storage capacity at the WWTRF is provided in **Table 5-2**.

Table 5-2 WWTRF Tertiary Storage Capacity

Tertiary Storage Basin	Conditions	Capacity (MG)
TSB 1	Existing	95
TSB 2	Existing	95
TSB 3	Future (WWTRF Expansion Project)	142
RSB	Interim Use (Existing RSB)	70
	Total Tertiary Storage Capacity:	**402**

5.4 DISTRIBUTION – RECLAMATION SYSTEM

The reclaimed water distribution system delivers recycled water from the WWTRF to the City's recycled water use areas. The distribution system consists of approximately twelve miles of transmission pipelines and the Reclamation Booster Pump Station (RBPS).

5.4.1 Pipelines

Portions of the existing distribution system consist of abandoned sewer force mains that were converted and reconstructed to convey recycled water as part of the City's Phase I Reclamation Project.

The existing distribution system can be divided into the following main pipelines:

- Moore Road Pipeline (18-inch): North bound transmission pipeline that extends from the Reclamation Booster Pump Station (RBPS) at the WWTRF, generally running along Moore Road and ending at Joiner Parkway.
- Joiner Parkway Pipeline (12-inch): Transmission pipeline extending north and south in Joiner Parkway from Venture Drive to Del Webb Blvd. The Joiner Parkway Pipeline provides service to the existing use areas within the City.
- Fiddyment Road Pipeline (24-inch): South bound transmission pipeline in Fiddyment Road, that extends from the RBPS at the WWTRF to Athens Avenue. This pipeline serves the County Leased disposal areas to the south and supplies agricultural user to the south-west.
- Machado Farm Pipeline (16- and 14-inch): Transmission pipeline that branches off the Fiddyment Road Pipeline to the west. This pipeline provides service to two agricultural use areas referred to as the Machado Farm.

The Phase I Reclamation Project expanded reclaimed water facilities at the WWTRF and extended the distribution system to sections of Moore Road, Joiner Parkway, and 9th Street, making recycled water available within the City. The overall project featured the construction and conversion of existing of 12-inch and 18-inch pipelines, improvements to the reclaimed booster pump station, and the addition of a surge protection system. The on-going Phase II Reclamation Project further extends the distribution system by adding three new system branches that extend from the Joiner Parkway Pipeline. This project is further described in **Section 2.4**.

5.4.2 Reclamation Booster Pump Station (RBPS)

The Reclamation Booster Pump Station (RBPS) is the only pump station within the distribution system and is located onsite at the WWTRF. The RBPS receives final fully treated effluent (reclaimed water), directly from the Effluent Pump Station (EPS). The RBPS was designed to include six pumps, five of which are currently installed. The design criteria of the existing RBPS is presented in **Table 5-3**.

Table 5-3 RBPS, Existing Equipment Specifications

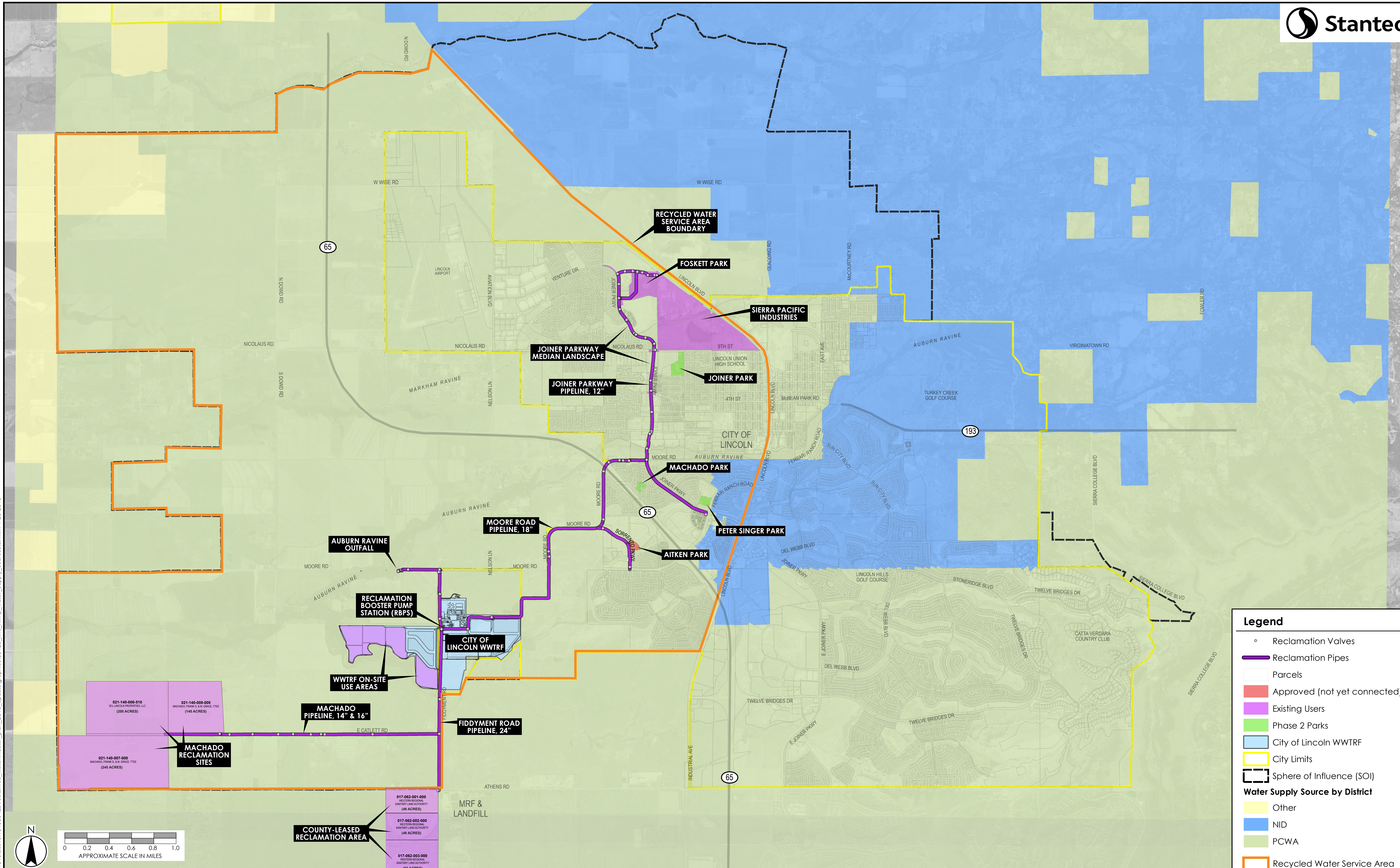
ID #	Pump Name	Manufacturer	Rating (1)	HP
PMP 48111	RBPS Pump 1	Floway	1,100 gpm at 180 TDH	75
PMP 48112	RBPS Pump 2	Floway	1,100 gpm at 180 TDH	75
PMP 48113	RBPS Pump 3	Floway	1,100 gpm at 180 TDH	75
PMP 48114	RBPS Pump 4	Floway	1,100 gpm at 180 TDH	75
PMP 48115	RBPS Pump 5	Floway	1,100 gpm at 180 TDH	75

1. Pump rating corresponds to system curve.

The maximum pumping capacity of the existing RBPS is approximately 7.9 MGD, and the reliable capacity is approximately 6.3 MGD. The reliable capacity is determined under the assumption that one of the five pumps is out of service and the remaining pumps operate in parallel. A 10,000-gallon pneumatic tank is used to regulate pressure and minimize surges in the distribution system. The peak flow recorded at the RBPS in 2017 was 7.8 MGD, which is roughly equivalent to its maximum pumping capacity.

5.4.3 Recycled Water Service Area

The City identified the need to limit the bounds of the recycled water service area and prioritize demands that exist at lower elevations on the east side of the City as part of this Master Plan update. This planning decision considers the relative availability of other non-potable water sources in the eastern portion of the City, and that the elevation and greater distances between potential use sites would make serving these areas cost prohibitive. Additionally, beyond the identified potential uses within the City's General Plan area, no significant recycled water demand potential was identified beyond the SOI boundary to the east of the City. The future limits of the recycled water service area, the existing distribution system, and approximate water service area boundaries of other non-potable water sources are shown on **Figure 5-1**.



City of Lincoln
Reclamation Master Plan

Figure 5-1
Existing Recycled Water Distribution System

5.5 DISPOSAL – USE AREAS AND DISCHARGES

Disposal and reclamation of final effluent occurs through a network of pumps, pipes, and land referred to as the Effluent Distribution System (EDS), generally located within the vicinity of the WWTRF.

5.5.1 Effluent Distribution System (EDS)

The EDS is supplied by the Effluent Pump Station (EPS) with a low-pressure water supply for distribution to downstream facilities, with the exception of some of the on-site irrigation areas which can be supplied directly from the TSBs. The pumped effluent is distributed to the required locations using flow meters, check valves (backflow preventing), and throttling valves, to ensure that the correct quantity is delivered to each destination.

The EDS can deliver effluent to any combination of the following five locations:

1. Auburn Ravine Creek Outfall, surface water discharge
2. On-site Reclamation Area 1, located west of the Maturation Ponds
3. On-site Reclamation Area 2, located south of the Emergency Storage Basins
4. Off-site Reclamation Areas, via the Reclamation Booster Pump Station (RBPS) and reclamation distribution system
5. Tertiary Storage Basins (TSBs), 190 MG used for strategic storage

A schematic of the existing effluent distribution system is shown on **Figure 5-2.**

Effluent from the WWTRF is of sufficient quality to allow unrestricted reuse. The existing permit narrative requires that priority is given to reclamation before discharging effluent to surface waters. There are currently three ways to reuse effluent produced from the WWTRF, on-site irrigation, agricultural irrigation, or off-site City reclamation (demands within the City). Uses of recycled water within the City include irrigation of parks, median landscapes, agriculture, and industrial cooling and process water. During times of minimal recycled water use, recycled water is discharged to Auburn Ravine Creek in accordance with the WWTRF's waste discharge permit.

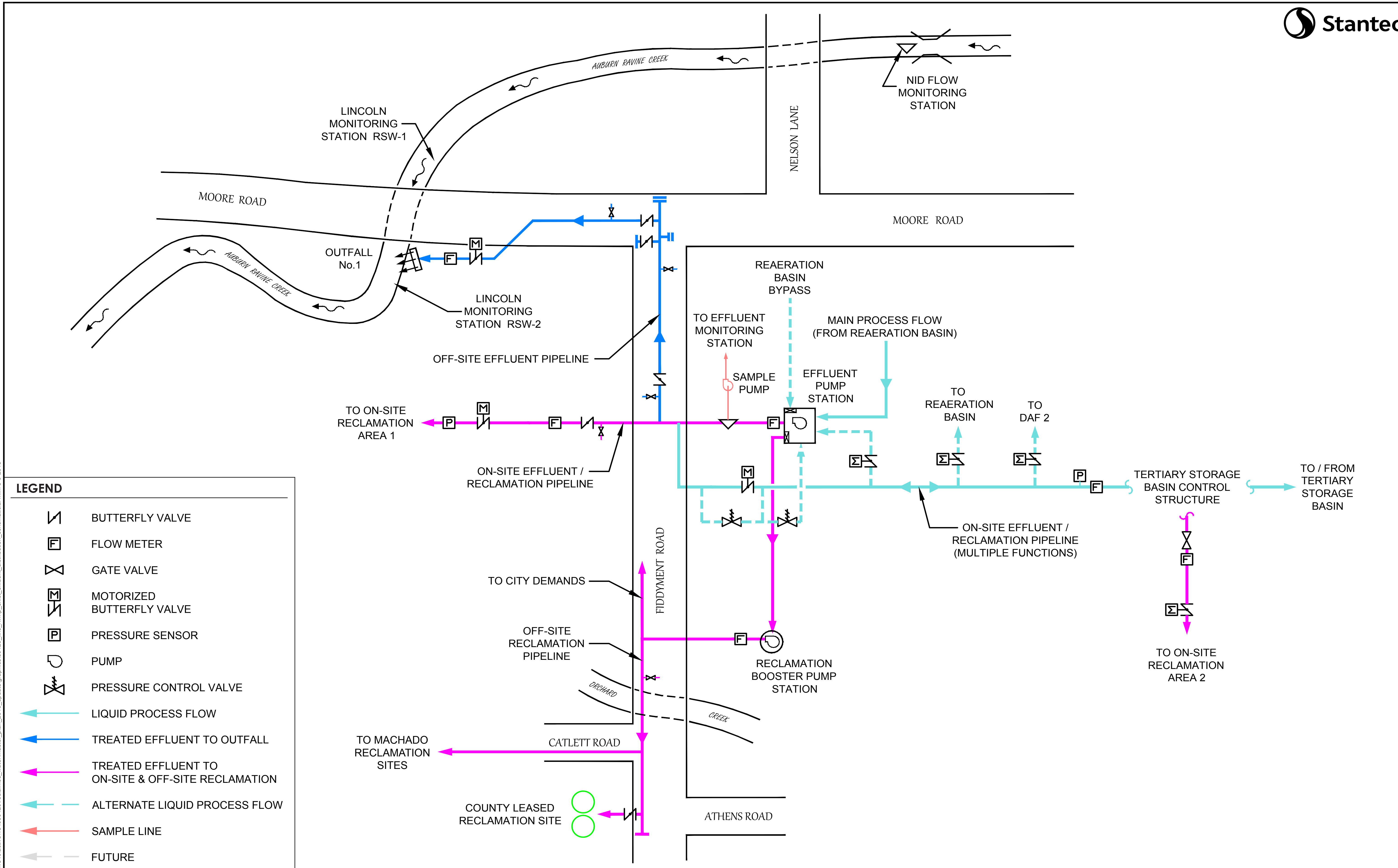


Figure 5-2
Existing Effluent Distribution System Schematic

Existing Use Areas and Disposal Types:

- Discharges to Auburn Ravine
  - Outfall
- On-site Irrigation
  - Warm Springs Irrigation
- Off-site City Reclamation
  - Sierra Pacific Industries (SPI)
  - Joiner Parkway Landscape Medians
  - Use in Construction
  - Foskett Regional Park (pending final connection)
- Agricultural Irrigation
  - County Leased Reclamation Area
  - Machado Farm Irrigation

5.5.2 Auburn Ravine Creek Outfall

The discharge of treated wastewater to Auburn Ravine Creek is regulated under Waste Discharge Requirements Order No. R5-2018-0081 (NPDES No. CA0084476). The quantity of water that is released to the Auburn Ravine outfall is controlled by variable frequency drive (VFD) settings on the EPS pumps and the position of the throttling valve on the discharge pipe. The City's NPDES permit limits effluent releases based on flow rate of the creek, in addition to temperature, pH, and the dissolved oxygen concentration of effluent and the creek. Outfall discharge is critical and the most restrictive constraint to the effluent management. Allowable creek discharge must be optimized when determining allowable discharge flows. Without means to adjust the effluent temperature, temperature-based restrictions have been historically the most limiting constraint. Further discussion of the effluent management and creek discharge is provided in **Section 7.4**.

5.5.3 Off-site City Use Areas

The existing uses of recycled water within the City include: the irrigation of landscape medians along Joiner Parkway, industrial use at Sierra Pacific Industries (SPI), and use in construction, primarily for dust control activities. The City converted Foskett Regional Park, the largest park within the City, to use reclaimed water for irrigation in 2018. The Phase II Reclamation Project will further extend the distribution system, providing recycled water service to three more City parks for landscape irrigation.

5.5.4 Agricultural Use Areas

Recycled water is currently used for agricultural uses at two locations, the County Leased Reclamation Area and the Machado Farm. The City has an existing lease agreement for reclamation on parcels owned by Placer County and a recycled water use contract in place with the Machado Family Farm. The County Leased Reclamation Area consists of three parcels equating to approximately 192 total acres. This area is currently farmed to grow fodder crops. The Machado recycled water agreement allows the use of recycled water on three parcels sharing a common irrigation system. These three parcels equate to approximately 590 gross irrigation acres. The formal recycled water agreement outlines the minimum recycled water usage amount and other infrastructure, cost, compliance, and supply parameters.

5.5.5 On-site Reclamation Areas

Approximately 180 acres of land on the WWTRF property are dedicated to land disposal of effluent. The area of the on-site irrigation fields is shown in **Table 5-4**. Fields 6 and 7 are not currently set up for farming or reclamation. Approximately 160 acres is currently used for land disposal.

Table 5-4 WWTRF On-Site Reclamation Areas

On-site Reclamation Field	Approximate Area (Acres)
F1	20.2
F2	21.5
F3	27.0
F4A	9.4
F4B	4.3
F5	26.6
F6 (1)	33.1
F7 (1)	41.8
Total On-site Reclamation Area:	183.9 (2)

1. Fields 6 and 7 are not currently set up for proper farming and therefore cannot be counted as reliable reclamation land area.
2. Total reliable on-site reclamation area is approximately 110 acres.

Reclaimed water may be applied to the on-site reclamation fields from April through October at a rate that does not exceed the agronomic rate of the planted vegetation. During the growing seasons, the operators must carefully coordinate water delivery with the farming operation to ensure that crops are not adversely affected by water shortages or over application.

6.0 RECYCLED WATER DEMANDS

6.1 PURPOSE

This chapter presents a discussion of the City recycled water usage data and recycled water demand projections used in the development of this Master Plan. The City's historical recycled water usage data is presented first, followed by a discussion of the recycled water demand factors, peaking factors, and other assumptions used to estimate the recycled water demand potential of future recycled water users. A recycled water market assessment is also presented to discuss previously considered potential recycled water demands. This chapter concludes with a summary of the recycled water demands and projections.

This chapter is divided into the following sections:

- Existing Recycled Water Use
- Recycled Water Demand Types and Peaking Factors
- Future Recycled Water Demand Estimates
- Market Assessment
- Summary of Recycled Water Demands

6.2 EXISTING RECYCLED WATER USE

The locations of the City's existing recycled water use areas and the existing reclamation system have been presented on **Figure 5-1**. Off-site City reclamation activities were initiated in 2017 with the connection of the irrigation system within the landscape medians along Joiner Parkway and the approval of Sierra Pacific Industries (SPI) for industrial use. The existing reclamation meter records and flow data are limited due to the short duration of service. Data from 2017 is presented in **Table 6-1**.

Table 6-1 Historical Recycled Water Use (2017)

Recycled Water User	Average Annual Use (MGD)	Maximum Month Use (MGD)	Total Annual Use (AF/yr)	Month of Maximum Use (2017)
On-site Irrigation (Warm Springs Irrigation)	0.09	0.64	101	August
County Leased Reclamation Area	0.30	1.01	333	September
Machado Farm Irrigation	1.28	4.72	1,433	July
Off-site Reclamation (SPI and Joiner Parkway Medians)	0.04	0.17	46	June
Total Reclamation:	**1.71**	**5.78**	**1,913**	**July**
Discharges to Auburn Ravine	2.89	8.16	3,235	January

The total wastewater volume treated at the WWTRF in 2017 was 1,911 MG (5,864 AF), of this volume approximately 1,277 MG (3,919 AF) was contributed by the City of Lincoln. Approximately 55% of effluent flow was directed to Auburn Ravine, 33% was directed to the RBPS, 2% was sent to on-site irrigation, and 10% was directed to storage. The RBPS supplied approximately 590 MG (1,812 AF) of recycled water to SPI, the Joiner Parkway Medians, construction uses, the Machado Farm, and the County Leased Reclamation Area. The Machado Farm took approximately 80% of the recycled water sent to the RBPS. Based on discussions with WWTRF operators, existing agricultural users are typically supplied on a 24-hour basis during MMD conditions.

The average day demand (ADD) in 2017 was approximately 1,900 AF/yr or 1.71 MGD. **Figure 6-1** shows the seasonal distribution of demand for the existing users based on monthly demand averages for 2017. As shown in this figure, the demands increase significantly during the summer due to higher temperatures and less precipitation. The Machado Farm is currently the largest user of recycled water.

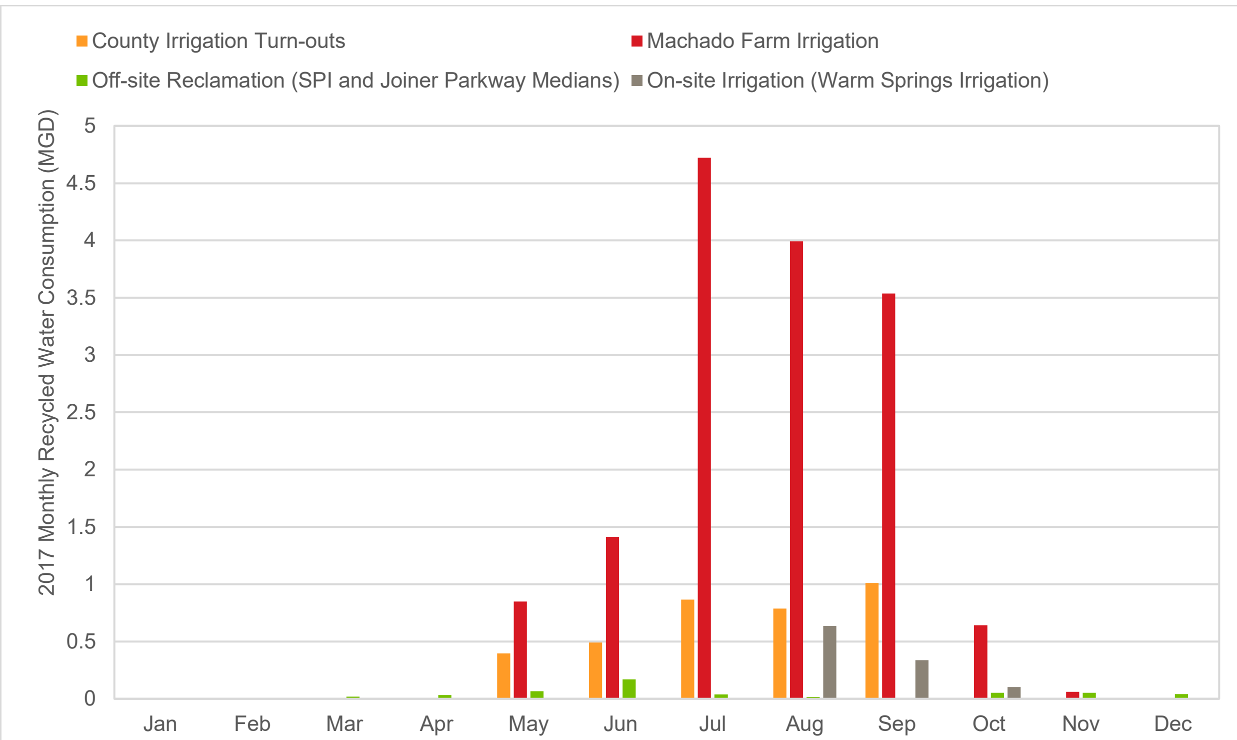


Figure 6-1 2017 Seasonal Demand Distribution for Existing Users

6.3 RECYCLED WATER DEMAND TYPES AND PEAKING FACTORS

This section discusses the water demand factors and peaking factors that were used to approximate future recycled water demands and operating conditions within the distribution system. The definition and application of these factors is discussed below.

6.3.1 Average Daily Demand (ADD)

The Average Daily Demand (ADD) represents the average demand in one calendar year or the total annual demand divided by 365 days. This value is typically derived from water meter records or approximated based on per-acre or per-capita recycled water demand factors. A water demand factor is defined as the estimated amount of water usage per area of a certain land use type or per person. These demand factors can be used to estimate the ADD for development areas by multiplying the demand factor (gpm/acre) by the total area of the corresponding land use designation or population. The City has provided base recycled water demand estimates for areas within its SOI and historical potable water meter records for users that will convert to recycled water use in the future. City provided the demand estimates used in this Master Plan as opposed to developing demand factor-based estimates.

6.3.2 Irrigation Requirements

Landscape irrigation requirements for the City of Lincoln were calculated based on evapotranspiration (ET) and average rainfall data. The amount of irrigation water required by the potential customers is directly dependent on precipitation and evapotranspiration quantities in the region and the efficiency of the irrigation system. To calculate the amount of ET occurring in the study area, the following formula is used: $ET_L = K_L * ET_0$

ET_L = Evapotranspiration of Landscaped Areas (inches)

K_L = Crop Coefficient (landscaping/turf grass/etc.)

ET_0 = Reference Evapotranspiration (inches)

The reference evapotranspiration for the area was developed based on an average of those provided for neighboring communities (Auburn, Davis, and Fair Oaks), obtained from the California Irrigation Management Information System (CIMIS). A crop coefficient of 0.7 was used, corresponding to a mixture of cool season and warm season turf grass species. The landscape coefficient was multiplied by the reference evapotranspiration to determine the average landscape evapotranspiration for the area. The amount of precipitation, evapotranspiration, and calculated irrigation requirement for landscape irrigation in the City of Lincoln, are listed in **Table 6-2**. As shown on **Figure 6-2**, the net annual average landscape irrigation requirement in the study area is approximately 30.9 inches per year or about 2.7 feet per year. Based on this data, recycled water demand factor was estimated as 2.7 AF/yr for each irrigated acre, which is equivalent to 2,400 gpd/acre.

Table 6-2 Average Annual Landscape Irrigation Requirements

Month	Average Precipitation (inches) (1)	Evapotranspiration (inches) (2)	Net Irrigation (inches) (3)	Net Irrigation Requirement (%) (4)
Oct	1.3	2.6	1.5	5%
Nov	3.0	1.3	0.5 (5)	2%
Dec	4.2	0.8	0.0	0%
Jan	4.8	0.9	0.0	0%
Feb	4.5	1.4	0.0	0%
Mar	3.7	2.4	0.5 (5)	2%
Apr	1.6	3.4	2.2	7%
May	0.9	4.6	4.4	14%
Jun	0.2	5.4	6.1	19%
Jul	0.0	5.7	6.7	21%
Aug	0.0	5.1	6.0	19%
Sep	0.4	3.8	4.0	13%
Total	**24.6**	**37.4**	**30.9**	**100%**

1. Source: Sacramento 5 ESE, NCDC 1981-2010 Monthly Normal Rainfall, scaled to an average annual total of 24.7 inches, Lincoln average rainfall total based on FERIX data for 1947-2005.
2. Source: data was obtained from the California Irrigation Management Information System (CIMIS). ET values are adjusted for the landscape irrigation coefficient (K_L = 0.7).
3. [Evapotranspiration – Rainfall] /0.85, Where 0.85 = 85% Irrigation Efficiency Factor
4. Current month net irrigation requirement divided by annual total irrigation requirement.
5. Added to account for irrigation that occurs in the spring and fall since storm events are not evenly distributed throughout the season.

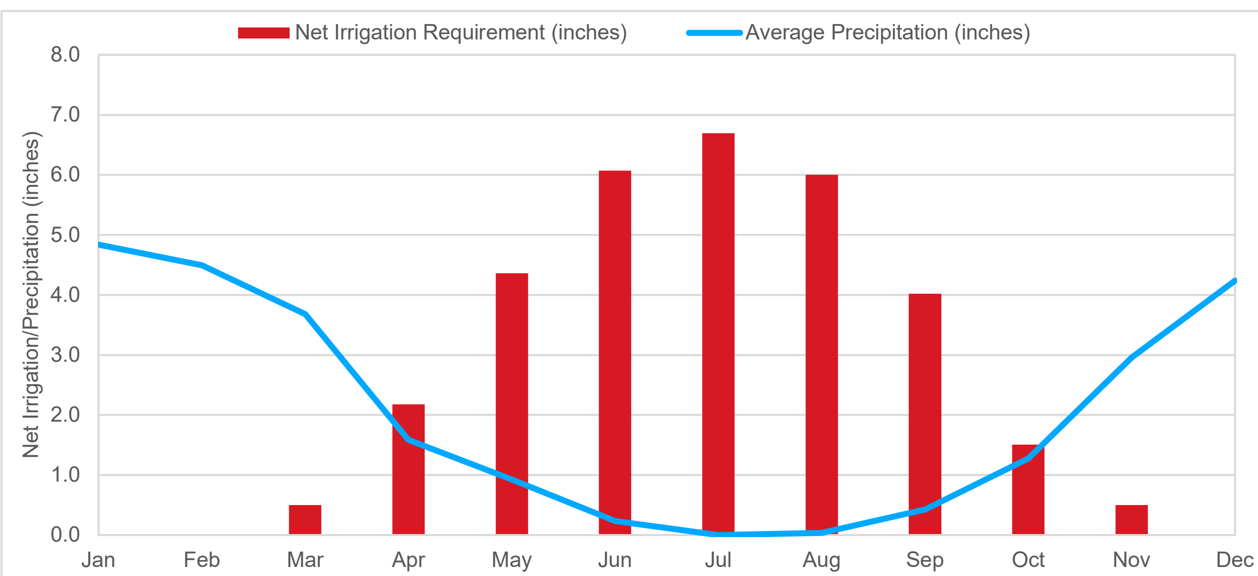


Figure 6-2 Net Irrigation Requirement (City of Lincoln)

6.3.3 Maximum Month Demand (MMD)

The Maximum Month Demand (MMD) is the average demand during the peak month of recycled water use. The MMD is often considered the most representative demand condition due to high irrigation use and variability in annual demands. In recycled water systems, the Maximum Day Demand (MDD) is roughly 10% higher than the MMD because irrigation sprinkler systems are typically only changed on a seasonal basis, rather than a daily basis, unless moisture sensors are utilized. For purposes of this Master Plan, it will be assumed that MMD and MDD are equivalent. Hence, the MMD/ADD ratio is used to estimate the MDD that the City needs to plan for.

During hot summer days, water use is typically higher than on a cold winter day because of increased irrigation demands. Peaking factors are typically used to estimate water demands for conditions other than ADD, accounting for fluctuations in demands on a seasonal or hourly basis. Common peaking factors include those used to estimate maximum day demands (MDD) and maximum month demands (MMD).

The data listed in **Table 6-2** was used to estimate the seasonal variation in landscape demands (and it is assumed that the majority of the reclaimed water demands will follow an agronomic cycle, though industrial demands may vary from this assumption). The irrigation season runs from March through November, a period of nine months. The peak irrigation demand typically occurs in July, equating to approximately 6.7 inches, which is approximately 2.5 times higher than the average irrigation requirement of 2.7 inches (31.8 inches/12 months). Based on this ratio, the MMD peaking factor of 2.5 is used in this Master Plan.

6.3.4 Peak Hour Demand (PHD)

Variations in water demands also occur during a 24-hour period, representing the rate of application of MMD flows throughout the day. Recycled water systems with high irrigation use, typically experience peak demand periods late at night through the early morning hours (to limit impacts to land uses during the day, such as at City parks due to sprinkler operations). Diurnal curves are used to represent the variations in recycled water demand that occur throughout the day. Peaking factors that result from these diurnal curves are dependent on the typical recycled water usage patterns associated with these irrigation cycles. For purposes of this Master Plan it was assumed that typical irrigation cycles would have an 8-hour duration, resulting in a peaking factor of 3.0 when applied to the MMD. Demands associated with industrial uses and use in construction were assumed to have a 24-hour supply cycle, resulting in a peaking factor of 1.0.

A summary of demand types and peaking factors is presented in **Table 6-3**.

Table 6-3 Demand Types and Peaking Factors

Demand Type	Abbreviation	Peaking Factor	Calculation Method
Average Day Demand	ADD	NA	Annual Demand Volume/ 365 days
Maximum Month Demand	MMD	PF = 2.5	MMD = ADD x 2.5
Maximum Day Demand	MDD	PF = 2.5	MDD = ADD x 2.5 MMD = MDD
Peak Hour Demand (1) 8-hour supply cycle 12-hour supply cycle 24-hour supply cycle	PHD	PF = 3.0 PF = 2.0 PF = 1.0	PHD = MMD x 3.0 or ADD x 7.5 PHD = MMD x 2.0 or ADD x 5.0 PHD = MMD x 1.0 or ADD x 2.5

1. 8-hour supply cycle assumed for irrigation demands and 24-hour supply cycle assumed for agricultural demands.

6.4 FUTURE RECYCLED WATER DEMAND ESTIMATES

The future recycled water distribution system will supply the demands of off-site reclamation areas within the City's recycled water service area. Estimates of these future demands have been developed for the following types of users:

Existing Users [3]: Users that currently use, or are entitled to use recycled water

Future Users [4]: Users that will convert to recycled water to meet non-potable demands

New Users [5]: Users that will use recycled water, but have not yet been developed

The future reclamation system has been planned to supply potential demands that exist at an elevation of approximately 160 feet above sea level or less. This portion of the City planning area is generally bounded by Lincoln Boulevard to the east, and the City's SOI boundary to the west. For the purposes of this Master Plan, it is assumed that non-potable demands within the City's recycled water service area will be supplied by the reclamation system.

Demands outside of the City's recycled water service area, but within the City's SOI are assumed to be supplied by the other non-potable supply sources within the City's portfolio. Therefore, delivery of recycled water is focused on the City's west side, where greater localized demand within the City planning area occurs and service can be extended to potential new uses west of the City. The service area may be expanded to the east in the future if significant demand and benefit develop. However, higher head pumps will be needed to overcome the higher elevation at the east.

[3] The demands of existing agricultural users and on-site reclamation will be replaced by those of the City's SOI upon its development. Therefore, these demands are excluded from long-term and buildout development scenarios.
[4] Existing entities currently supplying non-potable demands with potable water.
[5] Planned development areas existing within the City's SOI.

Estimates of the potential recycled water demands of these users have been developed for purposes of this Master Plan. Future demands and the City's recycled water service area are described in this section.

6.4.1 Existing Users

The City's existing recycled water use areas, users, and uses have been described in **Section 5.4** and **Section 6.2**. Existing recycled water users and associated demands are presented in **Table 6-4**. Existing reclamation use types consist of agricultural uses, WWTRF on-site reclamation, and off-site City reclamation (irrigation and industrial use). It has been assumed that the user agreements and legal contracts of agricultural users will expire, and their demands will be replaced by City reclamation demands with the development of Village 6 and buildout of the SOI. It is also assumed that WWTRF on-site irrigation will be phased out as the WWTRF expands and more land area is needed for treatment facilities. This leaves only off-site City reclamation demands to be distributed and supplied through the City's reclamation system, under buildout development conditions.

Existing recycled water demand estimates for City reclamation areas were evaluated to ensure they are representative of future development conditions. Recycled water is currently stored in tanks and impoundments, used in industrial cooling towers, and used to hose down the log deck at Sierra Pacific Industries (SPI). To be conservative, it has been assumed that these demands may increase under future conditions.

Foskett Regional Park is a large park with high irrigation needs, the existing irrigation system limits the amount of water that can be applied at any given time and as a result the park is irrigated for a longer duration. Based on potable water meter records for the park from 2013 and 2015, it uses approximately 190 gpm during the peak month of irrigation. The future MMD for Foskett Regional Park assumes that improvements will be made to the existing irrigation system, which will allow the park to be irrigated more efficiently with a shorter supply cycle, resulting in a higher demand rate. The MDD estimates associated with irrigation of the Joiner Parkway median landscaping, Aitken Park, and Phase II Parks were developed based on historical potable water meter records and are assumed to be representative of future conditions.

Table 6-4 Summary of Existing City Reclamation Demands (within City)

Existing Recycled Water User	Use Type	PF	Existing MMD (1) (gpm)	Future MMD (gpm)	Future PHD (gpm)
Sierra Pacific Industries (SPI)	Industrial	1	130	280	280
Joiner Parkway Irrigation	City Irrigation	3	20	20	60
Foskett Regional Park	City Irrigation	3	190 (2)	280	840
Aitken Park	City Irrigation	3	10 (2)	10	30
Phase II Parks, upon connection Joiner Park Machado Park Peter Singer Park	City Irrigation	3	*0*	 50 20 55	 150 60 165
Use in Construction	Construction	1	Delivered as needed and available		
Total			**150 (3)**	**715**	**1,585**

1. Existing MMD were developed from potable water meter records from the maximum month of use in 2013 and 2015. It should be noted that State mandated water restrictions as a result of persistent drought, were in effect. SPI demand from Use Area Report.
2. Entitled but are not yet connected, Foskett Regional Park was connected during the development of this Master Plan.
3. Total excludes recycled water demands that are entitled but are not yet connected and are not currently using recycled water. Actual MMD for these areas, observed at the RBPS was 118 gpm, June 2017.

6.4.2 Existing Entities to Convert to Recycled Water

The City of Lincoln provided irrigation water meter records for entities within the City that may convert to use recycled water in the future. These future users include cemeteries, schools, parks, public facilities, streetscape and other City owned or operated facilities within City limits. The historical potable water meter records were used to estimate the potential recycled water demands of these users. Future MMD estimates were established from data recorded during the month with the highest total potable water use of 2013 and 2015. Specific demands established in the 2004 Reclamation Master Plan were used for Lincoln High School and the Lincoln Crossings subdivision development. A figure showing the location of these demands is presented as **Figure 6-3.** To provide a conservative estimate of future conditions, these demands were assumed to be associated with irrigation, resulting in the use of a peaking factor of 3.0 throughout. These future demand estimates are summarized in **Table 6-5**.

Table 6-5 Future Reclamation Demands of Existing Entities

Recycled Water Users	Use Type	PF	Future MMD (gpm)	Future PHD (gpm)
Cemeteries	City Irrigation	3	50	150
Schools	City Irrigation	3	50	150
Parks	City Irrigation	3	60	180
Facilities	City Irrigation	3	10	30
Streetscape	City Irrigation	3	60	180
Other Depts.	City Irrigation	3	40	120
Lincoln Crossings [(1)]	City Irrigation	3	350	1,050
Lincoln High School [(1)]	City Irrigation	3	110	330
Total			**730**	**2,190**

1. These demands were established as part of prior planning, remaining demands were established using historical potable water meter records from the highest month of use during 2013 and 2015.

A detailed list of the included entities and future demand estimates is provided in **Appendix B**.

6.4.3 New Recycled Water Users

New recycled water user demands can be defined as those associated with the Villages and SUDs within the SOI that have yet to be developed or are currently developing. Demand estimates for these areas were provided by the City. These demands are assumed to have an irrigation demand pattern, resulting in a peaking factor of 3.0. A summary of new recycled water user demands is provided in **Table 6-6**.

Table 6-6 Summary of SOI Area Demands

SOI Area	Use Type	PF	Future MMD (gpm)	Future PHD (gpm)
Village 1 [(1)]	City Irrigation	3	0	0
Village 2 [(1)]	City Irrigation	3	0	0
Village 3 [(1)]	City Irrigation	3	0	0
Village 4	City Irrigation	3	405	1,215
Village 5/SUD-B	City Irrigation	3	1,140	3,420
Village 6	City Irrigation	3	605	1,815
Village 7	City Irrigation	3	700	2,100
SUD-A	City Irrigation	3	205	615
SUD-C	City Irrigation	3	0	0
Total			**3,055**	**9,165**

1. Village lies outside the bounds of the recycled water service area

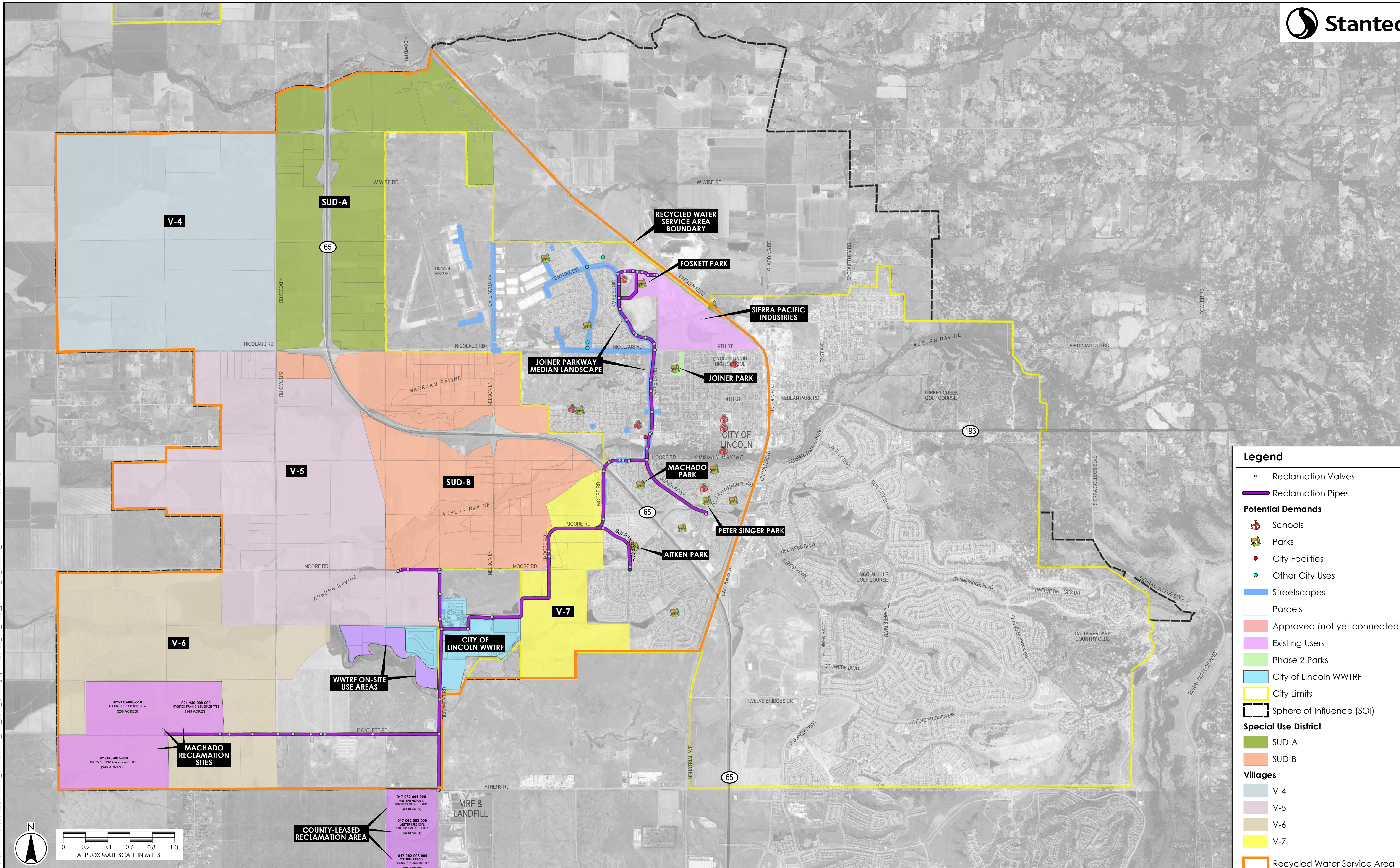


Figure 6-3
Recycled Water Demand Locations

6.5 MARKET ASSESSMENT

The City's 2004 Reclamation Master Plan considered demands that have been excluded in this Master Plan update. The demands previously considered are summarized in **Table 6-7,** including those associated with golf courses within the City, the Placer County Regional Landfill and Material Recovery Facility (MRF), the Rio Bravo Power Plant, the Formica Company, and Livingston Concrete.

Golf courses that had previously been considered to potentially use recycled water include the Twelve Bridges Golf Course, the Lincoln Hills Golf Course, the Del Webb 9-hole Course, and the Turkey Creek Golf Course. These golf courses are considered suitable for recycled water use but lie outside of the revised City service area and have already secured other water sources for irrigation. The Nevada Irrigation District (NID) supplies raw water for irrigation to the Turkey Creek Golf Course and the Del Webb Golf Course. Placer County Water Authority (PCWA) has individual raw water supply contracts with both the Twelve Bridges Golf Course and Del Webb Golf Course. For purposes of this Master Plan, it is assumed that these golf courses will continue to be supplied by raw water in the future due to their relatively high elevation and high potential demands.

The Placer County Regional Landfill and MRF, Rio Bravo Power Plant, Formica Company, and Livingston Concrete have all been omitted from this Reclamation Master Plan because they are located within Placer County, south of the City's existing and future boundaries. Demands within the City of Lincoln will take priority over those outside of city limits and the SOI. It should be noted that these facilities may have the opportunity to be supplied with recycled water from the WWTRF in the future, depending on supply availability. Evaluating the infrastructure needed to supply these demands is outside of the scope of this Master Plan. A summary of the demands of users previously considered is presented in **Table 6-7**.

Table 6-7 Excluded Demands Previously Considered (2004 Master Plan)

Recycled Water User	Use Type	PF	MDD (gpm)	Notes
Landfill MRF	Industrial	1	76	Outside City Bounds
Power Plant	Industrial	1	278	Outside City Bounds
Formica Company	Industrial	1	347	Outside City Bounds
Livingston Concrete	Industrial	1	35	Outside City Bounds
Twelve Bridges	Irrigation	1	750	Assumed to be out
Del Webb/ Lincoln Hills	Irrigation	3	1,250	Assumed to be out
Turkey Creek	Irrigation	1	381	Assumed to be out
65 Bypass	Irrigation	2	556	Assumed to be out
Total			**3,673**	

The City's 30% Reclamation Master Plan was developed for purposes of understanding potential reclamation system facility costs and considered all potential demands that could be converted to use recycled water within the City and its SOI, including those that exist outside of the revised recycled water service area. The recycled water service area was reduced to limit pumping requirements within the reclamation system and due the relative availability of other non-potable water sources to these areas. Potential recycled water demands within the City that had been considered in the 30% Master Plan but have been excluded herein are summarized in **Table 6-8**.

Table 6-8 Potential Demands Outside of the Recycled Water Service Area (Included in the 30% Reclamation Master Plan)

Recycled Water User	MMD (gpm)
School	130
Park	153
Facilities	24
Streetscape	135
Other Depts	8
Village 1	601
Village 2	575
Village 3	588
Total	**2,214**

6.6 SUMMARY OF RECYCLED WATER DEMANDS

The MMD estimate of each recycled water user considered in this Master Plan is presented in **Table 6-9**, under existing and future conditions.

Table 6-9 Summary of Existing and Future MMD

Recycled Water Demand	Use Type	PF	Existing Demand MMD (gpm)	Future Demand MMD (gpm)
Sierra Pacific Industries (SPI)	Industrial	1	130	280
Joiner Parkway Irrigation	City Irrigation	3	20	20
Foskett Regional Park	City Irrigation	3	190	280
Aitken Park	City Irrigation	3	10	10
Phase II Parks	City Irrigation	3	0	125
Lincoln Crossing	City Irrigation	3	0	350
Lincoln High School	City Irrigation	3	0	110
Cemeteries	City Irrigation	3	0	50
Schools	City Irrigation	3	0	50
Parks	City Irrigation	3	0	60
Facilities	City Irrigation	3	0	10
Streetscape	City Irrigation	3	0	60
Other Depts.	City Irrigation	3	0	40
Village 4	City Irrigation	3	0	405
Village 5/SUD-B	City Irrigation	3	0	1,140
Village 6	City Irrigation	3	0	605
Village 7	City Irrigation	3	0	700
SUD-A	City Irrigation	3	0	205
County Leased Reclamation Area	Agriculture	1	1,600	0
Machado Properties	Agriculture	1	2,800	0
Total			**4,750** (1)	**4,500**

1. The existing total demand includes those from entitled parks.

This Master Plan considers four scenarios which represent varying levels of development within the City's planning area. These scenarios are simulated within the hydraulic model. The model results are then used to evaluate the needs of the recycled water distribution system and associated facilities under various levels of development.

Existing City System: The existing system scenario considers existing recycled water demands (SPI, Joiner Parkway Irrigation, Machado, and County Leased Reclamation Area) and the existing state of the reclamation system.

<u>Near-Term Development</u>: The near-term development scenario considers near-term planned improvements to the recycled water distribution system. This scenario represents system conditions upon completion of the Phase II Reclamation Project. The demands of entitled parks and those associated with the Phase II Reclamation Project are added to the existing system simulation. Off-site agricultural demands are still included in this scenario.

<u>Long-Term Development</u>: The long-term development scenario considers the addition of demands and infrastructure to support the connection of potential recycled water users within city limits, referred to as "existing entities to convert to recycled water" and described in **Section 6.4.2**. Future user demands are also included for developing areas of within the SOI for which a specific plan has been drafted. These demands include those of Village 5/SUD-B and Village 7. It is assumed that off-site agricultural demands have been phased out under this scenario.

<u>Buildout of the General Plan</u>: This scenario considers full buildout of the City's General Plan area and reclamation system. The future demands of existing users, existing entities to convert to recycled water use, and future recycled water users are included. The results of this scenario are used as a basis for planning the future reclamation system.

A summary of PHDs for each development scenario is presented in **Table 6-10**.

Table 6-10 Development Scenarios and PHD

Recycled Water Demand	Existing City System PHD (gpm)	Near-Term Development PHD (gpm)	Long-Term Development PHD (gpm)	Buildout of General Plan PHD (gpm)
Sierra Pacific Industries (SPI)	130	280	280	280
Joiner Parkway Irrigation	60	60	60	60
Foskett Regional Park		840	840	840
Aitken Park		30	30	30
Phase II Parks		375	375	375
Cemeteries			150	150
Schools			150	150
Parks			180	180
Facilities			30	30
Streetscape			180	180
Other Depts			120	120
Lincoln Crossing			1,050	1,050
Lincoln High School			330	330
Village 4				1,215
Village 5/SUD-B			3,420	3,420
Village 6				1,815
Village 7			2,100	2,100
SUD-A				615
County Leased Reclamation Area	1,600 (1)	1,600 (1)		
Machado Properties	2,800 (1)	2,800 (1)		
Total	**4,590**	**5,985**	**9,295**	**12,940**

1. Existing agricultural users have a 24-hour supply cycle during MMD conditions.